Science of Sight ~ Science on Wheels 2006-2007
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Standards and Benchmarks

Strand I: Scientific Thinking and Practice
Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

K-4 Benchmark I: Use scientific methods to observe, collect, record, analyze, predict, interpret, and determine reasonableness of data.
K-4 Benchmark II: Use scientific thinking and knowledge and communicate findings.

5-8 Benchmark I: Use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.
5-8 Benchmark II: Understand the processes of scientific investigation and how scientific inquiry results in scientific knowledge.

Standard II: Life Science: Understand the properties, structures, and processes of living things and the interdependence of living things and their environment.

K-4 Benchmark II: Know that living things have diverse forms, structures, functions, and habitats.

K- 1. Identify major structures of common living organisms.
2. Observe that differences exist among individual living organisms of the same kind.

1st- 2. Know that living organisms inhabit various environments and have various external features to help them satisfy their needs.
3. Describe the differences and similarities among living organisms.

2nd- 1. Observe that differences exist among individuals within a population.

3rd- 1. Know that an adaptation in physical structure or behavior can improve an organism's chance for survival.
2. Observe that plants and animals have different structures that serve different functions.

4th- 1. Explain that different living organisms have distinctive structures and body systems that serve specific functions.
2. Know that humans and other living things have senses to help them detect stimuli, and that sensations and stimuli influence the behavior of organisms.

K-4 Benchmark III: Know the parts of the human body and their functions.

K- 1. Use the senses to observe surroundings and describe the observations.
2. Identify the parts of the human body and the functions of these parts.

1st- 3. Describe how some parts of human bodies differ form similar parts of other animals.

2nd- 1. Identify a variety of human organs.

4th- 1. Know that the human body has many parts that interact to function as systems.

5-8 Benchmark I: Explain the diverse structures and functions of living things and the complex relationships between living things and their environments.

6th- 3. Describe how organisms have adapted to various environmental conditions.

5-8 Benchmark III: Understand the structure of organisms and the function of cells in living systems.

5th- 1. Understnd that all living organisms are composed of cells from one to many trillions, and that cells are usually only visible through a microscope.

7th- 2. Explain how organs are composed of tissues of different types of cells.

3. understand that many basic functions of organisms are carried out in cells, including: specialized functions of cells (ie. nerve-signal transmission.

5. Describe how some cells respond to stimuli (light)

8th- 3. Describe how chemical substances can influence cellular activity.

Vocabulary

pupil- the black aperture (hole) in the center of the iris of the eye through which light passes

iris- the colored part of the eye that controls the size of the pupil

compound eye- eye of most insects composed of many simple eyes each forming a portion of an image enabling it to see in many directions

peripheral vision- the outer area of the visual field

rectus medialis- muscle that controls eye movement

optic nerve- bundle of nerves carrying information from the retina of the eyes to the brain

blind spot- the small optically insensitive region where the nerve enters the

retina- the inner most part of the eye where light sensitive rods and cones are located

binocular – using both eyes simultaneously; having two eyes arranged to produce stereoscopic vision

lens- a transparent oval that adjusts the eye's focus for near or far vision.

myopia- nearsightedness, a visual defect in which distant objects appear blurred because the their images are focused in front of the retina

hyperopia- farsightedness, a visual defect in which near objects appear blurred because their images are focused behind the retina.

ops- Greek for eye

rod- cells in the retina that respond to motion and low levels of light. They allow you to see shades of gray.

cone- cells in the retina that respond to detail and color

Extension Activities

Real learning takes place when a student makes connections and ties new information to ideas that they have previously learned. These activities provide a few ideas for reviewing and extending the science concepts that we introduce in the "Science of Sight" Science on Wheels program. We hope that you will find something here that helps tie science to other lessons in your classroom!

Animal Eyes (Adaptations)

Materials: Collection of pictures of animals

1) Sort pictures according to eye characteristics.
   large eyes
   eyes on the side of the head
   eyes on the front of the head
   single lens- has a lens allowing one to focus
   compound eyes- made up of many separate units (insects)

Can you draw any conclusions? Is there anything else similar about the animal groups?

2) Sort pictures as predator or prey.
What do you notice?
What would happen to an animal that couldn't see all around?
   It would be captured.
Animals that are prey usually have eyes on the sides of their heads allowing them to see all around. Predators usually have eyes facing forward. This allows them to sense depth and distance when hunting.

3) Sort pictures according to when they are alert—nighttime (nocturnal) or daylight (diurnal). Nocturnal animals usually have much larger eyes, proportionally than diurnal.

4) Sort pictures according to whether they are insects or mammals. Insects have compound eyes. Mammals have single lens eyes.

Animal Eyes- Georgia O'Keeffe Style

Materials: examples of Georgia O'Keeffe pictures
pictures of animals (such as from old calendars or magazines)
cardstock
white paper for each student
colored pencils

The purpose of this activity is to have students look closely at the details of animal eyes. This will allow them to notice similarities and differences.

Begin by having students look at some of Georgia O'Keeffe's flower paintings. Notice how she took small simple flowers and enlarged them to fill great canvases. She found the beauty in the details of everyday objects around us.

Have students find pictures of animals. Then have each student make a viewfinder out of stiff paper (cardstock). Cut two large capital "L" shapes and place them (like a picture frame) around an eye and some of the surrounding area. Isolating the eye from the rest of the picture helps to draw attention to the lines, shapes, and composition of each eye. Have students study several eyes before choosing an interesting eye (just the eye and small surrounding area) to paint or draw in "Georgia O'Keeffe Style."

Do animals see in color?

Choose an animal and do some research to find out if it sees in color!

We think that some animals see in color because they have color sensitive cells in their eyes.
Birds see in color. They actually see a greater range of color than people, including ultraviolet light. Their cones are extra sensitive to orange, yellow and red. Some birds can spot prey up to two miles away. A hawk can see eight times more sharply than a human.
Bees and butterflies are extra sensitive to ultraviolet light. Many of the flowers that these insects pollinate give off ultraviolet signals.
Scientists believe that dogs see in color, but not as many colors as humans, because they only have two kinds of rods, and humans have three.
Snakes see infrared light that is invisible to the human eye.

Eye Color Graph
Create a class pictograph to record and compare the eye colors of the students in your class. Which color is the most common?

Eye Observations (student worksheet below)
Materials: mirror for each student
white paper
colored pencils

Discuss:
Your iris is unique! It is made of bunches of muscle fibers. Nobody has eyes exactly like yours. Some security systems can even use a digitized image of your eye to identify you.

Observe and Draw:
Give each student an 8 x 10 piece of paper (or any size you choose) and a mirror. Tell students to look into the mirror and draw a picture of one (or both) of their eyes including these parts: pupil iris eyelashes eyebrow. Draw it as accurately as possible!

Display:
Eye Identification
These can be displayed without names, so that people can guess the identity of the person.

My Unique Eye!

Your iris is unique! It is made up of bunches of muscle fibers . Nobody has an iris muscle pattern exactly like yours. Your right eye is even different from your own left eye! Some security systems can even use a digitized image of your eye to identify you.

Look into the mirror and draw a picture of one (or both) of your eyes with as much detail as possible. Remember to include these parts: pupil, iris, eyelid, eyelashes, and eyebrow.

PERSISTENCE OF VISION

Persistence of vision is the eye's ability to keep seeing an image of an object for a fraction of a second after the object has disappeared from view. The image of an object stays on your retina even after you've stopped looking at it for about 1/30th of a second. The principle of persistence of vision is used in making motion pictures and animated cartoons. Movies are a series of separate pictures, flashed on the screen at a speed of about 24 per second. When you're watching a movie, each picture stays on the retina long enough to merge with the next image, and you fool or trick your brain so that it thinks that it is seeing motion. This is where the term motion pictures comes from. You don't even notice that the movie screen is actually dark some the time! You can make two motion toys that will demonstrate the principle of persistence of vision.

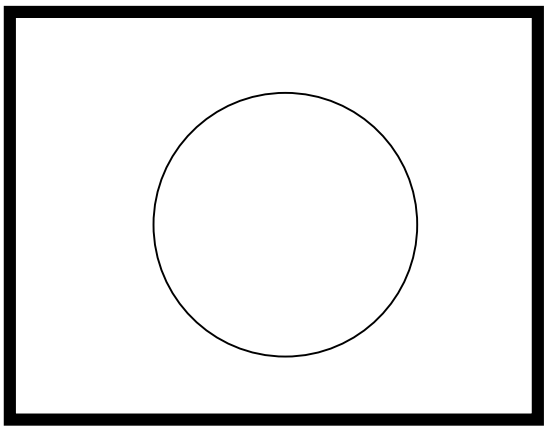
Thaumatrope

Supplies per student: two index cards
a pencil

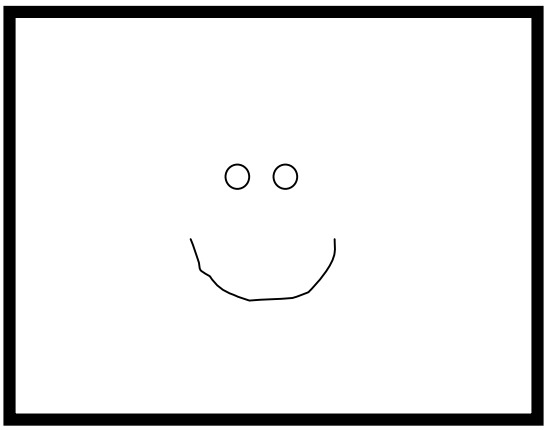
Draw an animal (like a bird) in the center of one card. Draw a cage in the center of the second card. Tape the cards back to back near the top (eraser) of the pencil. Place the pencil between your hands and twirl it between your palms. Try making your own mini-movies using different pictures!

What does this toy teach you about your vision? We have persistence of vision this makes it possible for us to view movies!

front



back



Mini-movie Flip book

Supplies per student:
- small pieces (3x5 or 4x6 inch size) of paper that can be stapled together. Index cards can also be used.
- pencils
- stapler

Movies and cartoons work the same way as a flipbook. A movie projector flashes one still picture after another very quickly onto the screen. Your brain blends one picture into the next one, giving you the illusion of movement. To make a flipbook create a series of pictures, each slightly different from the next. Staple the pictures in order. (It often helps to separate them a very tiny amount in order to "flip" them more easily.)

Brainstorm ideas for flipbooks before students begin. Encourage simple designs, such as a balloon blowing up and then popping, the sun setting, etc.

Students may enjoy researching more about animation or movie making. How do movie makers "fool" our eyes?

Optical Illusions

Have students collect optical illusions and find out why or how they work. What is happening? Why is our brain fooled?

Use what you learn to create your own optical illusions!

Two Eyes- One View!

Read the following instructions to your students:

1.Close your left eye.
2.Point at something in the room, like the teacher's head, a flag, or a poster.
4.Don't move your finger!
5.Now switch eyes. (Open your left eye and close your right.)
6.Did it look like your finger moved?
That's because each eye sees a slightly different view.

Build an Eye

supplies: paper cup
pin
wax paper
rubber band
light source (lamp)

Poke a hole in the middle of the bottom of a paper cup with a pin. Attach a piece of wax paper to the mouth of the cup and secure with a rubber band. Hold the pinhole end of the cup up to the lamp, about a foot away. Look at the wax paper on the end. Move the cup slowly away from the light. What happens?
What does each part of your model represent?

paper cup- eyeball
wax paper- retina
pinhole- pupil
you- the iris, you decide how big to make the hole

You will see an upside down image of the lamp appear on the wax paper. If this is how the image appears on the retina, why don't we see things upside down? Our brain flips the image right side up!

Philosophy
Give older students this question for an independent/ journal writing activity.

"Eyes are the windows to the soul." Descartes

Why do you think eyes are sometimes called this?
Explain what you think and why! Give an example.
Do you agree or disagree with this statement? Why or why not.
Give an example.

Debate
Read an article about iris identification. Do you feel that this technology should be used? In what situations would it be appropriate? When would it NOT be appropriate?
List the pros and cons of iris identification.

Eye Expressions
Explain what each expression really means.

see red
see eye to eye
have eyes on the back of your head
the apple of my eye
your eyes are bigger than your stomach
my eyes popped out of my head
beauty is in the eye of the beholder
to eyeball something
see the light
more than meets the eye
seen better days

Students could use the expression correctly in a sentence, draw a humorous interpretation, and then write the expression's meaning.

Water Drop Lenses (see activity sheet below)
This works best as a pair activity.
Supplies per student: one microscope slide
one eyedropper
a small cup of water
ruler
newspaper

Place one drop of water in the middle of the microscope slide. Look at the drop from the side and draw it. Choose one word that you plan to view with your slide and circle it. Place your slide on top of your circled word. What happens? Move the slide up and down until you get the word in focus. Measure the distance between the paper and the lens when it is in focus. What do you predict will happen if you use more drops of water?
Place another drop of water in the middle of the slide. Draw a side view of the water drop, and hold over the words again. What happens this time? Move the slide up and down until you get the words in focus. Measure and record the distance between the paper and the lens when it is in focus. Repeat this experiment by adding drops to the lens.

Water Drop Lenses

Supplies per student: one microscope slide
one eyedropper
a small cup of water
ruler
newspaper

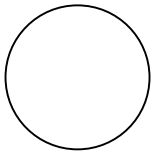
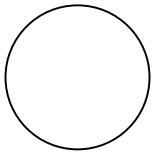
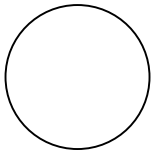
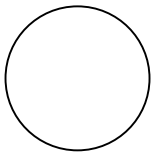
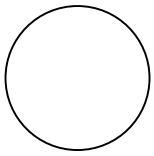
Instructions:

1. Place one drop of water in the middle of the microscope slide.
2. Look at the drop from the side and draw it on your record sheet.
3. Choose one word that you plan to view with your slide and circle it.
4. Place your slide on top of your circled word. Move the slide up and down until you get the word in focus. Draw what you see on your record sheet.
5. Measure the distance between the paper and the lens when it is in focus. Record. What do you predict will happen if you use more drops of water?

Repeat this experiment by adding drops to the water on your slide and record what happens each time.

Water Drop Lenses

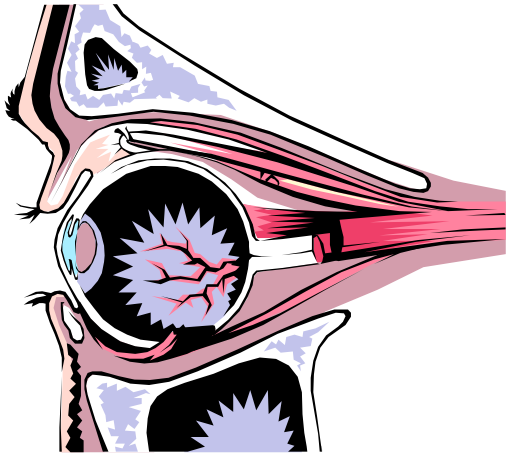
Record Sheet:

Number of drops	Draw a side view of your water drop	Draw the view through your lens	Record the distance needed to focus
	_____		
	_____		
	_____		
	_____		
	_____		

Using the information from your record sheet, draw some conclusions about lenses and magnification.

Los Alamos Science in Action!

Artificial
Retina
Project



Scientists at the Los Alamos National Laboratory are working to improve artificial retinas that allow people with impaired vision to see. Some scientists are **researching** to find out what is physically happening in the eye that allows us to see. They are detecting precisely what is happening in the cells that make up the optic nerve by studying how they reflect light. Other scientists, such as those in the Biological and Quantum Physics group, are **using computers** to simulate or show how the cells are reacting. They create a computer code that predicts how the cells will react to a stimulus. After studying the research and models, scientists are now **designing** new ways to use electric currents or magnetic fields to stimulate the nerve cells in the retina to react like natural retinas. The amazing human brain can learn to interpret these artificial signals and use them as visual information.